UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	2666.62
First Named Inventor or Application Identifier	SEHAT SUTARDJA
Express Mail Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

1. [X] Fee Transmittal Form *(Submit an original, and a duplicate for fee processing)*
2. [X] Specification — *Total Pages* 46
3. [X] Drawing(s) *(35 USC 113)* — *Total Sheets* 12
4. [X] Oath or Declaration *Total Pages* 2
   - a. [X] Newly executed (original or copy)
   - b. [ ] Unexecuted for information purposes
   - c. [ ] Copy from a prior application (37 CFR 1.63(d)) *(for continuation/divisional with Box 17 completed)* ***[Note Box 5 below]***
     - i. [ ] DELETION OF INVENTOR(S) Signed Statement attached deleting inventor(s) named in the prior application, see 37 CFR 1.63(d)(2) and 1.33(b).
5. [ ] Incorporation By Reference *(useable if Box 4c is checked)* The entire disclosure of the prior application, from which a copy of the oath or declaration is supplied under Box 4c, is considered as being part of the disclosure of the accompanying application and is hereby incorporated by reference therein.
6. [ ] Microfiche Computer Program *(Appendix)*
7. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   - a. [ ] Computer Readable Copy
   - b. [ ] Paper Copy (identical to computer copy)
   - c. [ ] Statement verifying identity of above copies

ACCOMPANYING APPLICATION PARTS

8. [X] Assignment Papers (cover sheet & document(s))
9. [ ] 37 CFR 3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
10. [ ] English Translation Document *(if applicable)*
11. [ ] Information Disclosure Statement (IDS)/PTO-1449 [ ] Copies of IDS Citations
12. [ ] Preliminary Amendment
13. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
14. [X] Small Entity Statement(s) [ ] Statement filed in prior application Status still proper and desired
15. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
16. [ ] Other: _____

17. If a CONTINUING APPLICATION, *check appropriate box and supply the requisite information:*
    [ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No. ___/_____

18. CORRESPONDENCE ADDRESS

[X] Customer Number or Bar Code Label — 05514 (Insert Customer No. or Attach bar code label here) — or [ ] Correspondence address below

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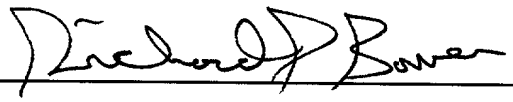
CLAIMS	(1) FOR	(2) NUMBER FILED	(3) NUMBER EXTRA	(4) RATE	(5) CALCULATIONS
	TOTAL CLAIMS (37 CFR 1.16(c))	172 -20 =	152	X $ 18.00 =	$2,736.00
	INDEPENDENT CLAIMS (37 cfr 1.16(b))	24 -3 =	21	X $ 78.00 =	$1,638.00
	MULTIPLE DEPENDENT CLAIMS (if applicable) (37 CFR 1.16(d))			$260.00 =	$000.00
				BASIC FEE (37 CFR 1.16(a))	$690.00
			Total of above Calculations =		$5,064.00
	Reduction by 50% for filing by small entity (Note 37 CFR 1.9, 1.27, 1.28).				$2,532.00
				TOTAL =	$2,532.00

19. Small entity status
    a. [X] A Small entity statement is enclosed
    b. [ ] A small entity statement was filed in the prior nonprovisional application and such status is still proper and desired.
    c. [ ] Is no longer claimed.

20. [X] A check in the amount of $ 2,532.00 for the filing fee is enclosed.

21. [X] Two (2) checks in the amount of $ 40.00 each to cover the recordal fee for two Assignments are enclosed.

22. The Commissioner is hereby authorized to credit any overpayments or charge any deficiencies to Deposit Account No. 06-1205:
    a. [X] Fees required under 37 CFR 1.16.
    b. [ ] Fees required under 37 CFR 1.17.
    c. [ ] Fees required under 37 CFR 1.18.

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED	
NAME	**RICHARD P. BAUER, REG. NO. 31,588**
SIGNATURE	
DATE	**September 11, 2000**

METHOD AND APPARATUS FOR RECORDING AND REPRODUCING DIGITAL DATA

Inventor: Sehat Sutardja

Cross-Reference to Related Application

This application claims priority under 35 U.S.C. § 119(e) on U.S. Provisional application serial No. 60/211,874, entitled "Method And Apparatus For Recording And Reproducing Digital Data, " filed June 14, 2000, the contents of which are incorporated by reference herein.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to an apparatus for recording and reproducing digital data. More particularly, the present invention relates to a media player/recorder, having a miniature hard disk drive for storing the digital data.

Description of the Related Art

Fig. 1 is an example of a conventional MP3 player. MP3 player includes an interface 106, nonvolatile solid state memory 102, an decoder 110, a digital-to-analog (D/A) converter 147, an audio output 116, a key pad 108, a display 112, a controller 104, RAM 144 and ROM 145.

Controller 104 controls the operation of the MP3 player in accordance with a set of programmed instructions. Programmed instructions for controller 104 are stored in nonvolatile memory or ROM 145, and RAM 144 is provided as the working memory for controller 104

Typically, MP3 data, which is a digital compressed format representing music data, is initially stored on a personal computer 50 and is subsequently transferred to the MP3 player via interface 106, under control of controller 104. The MP3 data is stored in nonvolatile solid state memory 102. Interface 50 can implemented by a standard parallel port, serial port, USB and the like. Nonvolatile solid state memory 102 may be implemented as flash memory. Generally, for a music quality recording, a nonvolatile solid state memory having 64 Mbytes can store about 1 hour of music.

Flash memory provides the capability of retaining the stored digital data even when the MP3 player is powered down. Once the digital data has been transferred to the MP3 player, it no longer needs to be connected to personal computer 50, and the MP3 player can play back the MP3 data autonomously from personal computer 50.

Decoder 110 functions to decode and decompress the MP3 data file stored in nonvolatile solid state memory 102. Decoder 110 decompresses the MP3 music file in accordance controller 104 according to the MP3 format, and decodes the decompressed music file into a bit stream form. The bit stream is then converted into analog form by digital to analog converter 147 for connection to a speaker, earphone and the like. A decoding program for the MP3 decoder function is stored in the ROM 145 and loaded to RAM 144 by controller 104 as required.

The MP3 player comprises a keypad 108 for allowing user control and interaction with the MP3 player. Such control may include power on/power off, music selection and volume. The MP3 also comprises a display 112 for displaying characters or graphics, such as a battery indicator, a play mode indicator, a volume indicator, available memory size and the title of the music being played.

One disadvantage of the conventional MP3 player is that the amount of music data stored in the MP3 player is limited by the amount of flash memory installed in the MP3 player. Flash memory is expensive which inapposite to such a portable consumer electronic device. Additionally, by incorporating a large amount of flash memory, there is an increase in required energy to supply the MP3 player. This results in a shorter operating time or and increase in weight for additional batteries to supply this increase in required energy. This is also disadvantageous for a portable device. Moreover the decoding algorithm is either store in the ROM or flash memory. When the decoding algorithm is stored in ROM, the ROM needs to be changed to update, revise or change the decoding algorithm. Moreover a larger ROM is required if multiple algorithms are stored therein. Similarly, if multiple algorithms are stored in flash memory, a larger flash memory is required, which increases cost and energy consumption.

Summary of the Invention

According to a first aspect of the present invention, a media player/recorder comprises a disk drive to store compressed media data, and a processor to retrieve the media data stored in the disk drive. A memory is provided to store the media data

retrieved by the processor. The processor decompresses the media data stored in the memory, and an output circuit outputs the decompressed media data from the processor.

According to a second aspect of the present invention, the memory comprises a dynamic access memory.

According to a third aspect of the present invention, the media player further comprises an interface responsive to the processor to communicate with an external device.

According to a fourth aspect of the present invention, the processor comprises a digital signal processor to control the disk drive and to decompress the media data stored in the memory.

According to a fifth aspect of the present invention, the processor comprises a single integrated circuit comprising a digital signal processor to control the disk drive and to decompress the media data stored in the memory, a storage controller is responsive to the digital signal processor, and a read channel reads data from the disk drive and responsive to the storage controller.

According to a sixth aspect of the present invention, the digital signal processor comprises a decoder to decompress the media data stored in the memory.

According to a seventh aspect of the present invention the disk drive stores a process for decompressing compressed data for a selected compression format.

According to an eleventh aspect of the present invention, the digital signal processor determines a compression format of the media data stored in the memory, wherein the process for decompressing compressed data is retrieved from the disk drive in accordance with the determined compression format, and wherein the decoder decompresses the media data in accordance with the retrieved process.

According to an twelfth aspect of the present invention, the media data is transferred from the external device through the interface for storage on the disk drive.

According to an thirteenth aspect of the present invention, the media player further comprises an input circuit to receive media data, wherein the digital signal processor comprises an encoder to compress the received media data, and wherein the compress media data received by the input circuit is stored on the disk drive.

Other objects and attainments together with a fuller understanding of the invention will become apparent and appreciated by referring to the following description and claims taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

In the drawings wherein like reference symbols refer to like parts.

Fig. 1 is a block diagram of a conventional MP3 player;

Fig. 2 is a block diagram of a first embodiment of a media player/recorder in accordance with the present invention;

Fig. 3 is a more detailed block diagram of the media player/recorder of Fig 2;

Fig. 4 is a block diagram of a second embodiment of a media player/recorder in accordance with the present invention;

Fig. 5 is a more detailed block diagram of the media player/recorder of Fig 4;

FIG. 6 shows an exemplary data format of a magnetic disk having a plurality of concentric tracks comprised of a plurality of user data sectors and embedded servo data sectors;

FIG. 7 is a schematic representation of memory 202;

FIG. 8 is a memory map of memory 202;

FIG. 9 is flow chart of an energization/deenergization procedure according to a first embodiment of the present invention;

FIG. 10 is flow chart of an energization/deenergization procedure according to a second embodiment of the present invention;

FIG. 11 is flow chart of an energization/deenergization procedure according to a third embodiment of the present invention; and

FIG. 12 is flow chart of an operating procedure according to the present invention.

Description of the Preferred Embodiments

The present invention is directed to a media player/recorder apparatus, and in particular one that is portable. As used herein the term media player/recorder apparatus refers to an audio and/or video play back and recording apparatus. In

general, audio and/or video analog data is first digitized and compressed using one of a variety of formats and recorded in the media player/recorder for subsequent play back thereby. During playback the digitized data is decompressed and converted to an analog signal. Additionally while the preferred format for compressing audio data is known as MP3, the present invention is independent of the compression format and not limited to MP3. The compression format therefore may include any other suitable compression format, such as, by way of example, EPAC ™, QDesign Music playback, AAC, Liquid Audio, MS Audio, Dolby Digital, and the like.

Referring to Fig. 2 there is shown the first embodiment of media player/recorder of the present invention. The media player/recorder includes an interface 206, memory 202, a processor 300, an output 216, a keypad 208, a display 212, a storage device (the storage device may utilize, for example, a magnetic media (such as a hard disk drive), magneto-optical media, an optical media (such as a CD ROM, CDR, CDRW or the like), and the like) such as, a disk drive 230, a preamp 232 and a voice coil motor (VCM) 234.

The operation of the media player/recorder is as follows. Operation of the media player/recorder is controlled by the user through keypad 208. Status of the media player/recorder is provided to the user by display 212.

Media data, which was previously digitized, may be obtained (downloaded) from a personal computer, network appliance, local area network, Internet 50 and the like. Such external devices communicate with the media player/recorder via interface 206, which is controlled by processor 300. Interface 206 may be implemented, for example, as a parallel interface, serial interface, USB, Ethernet connection, IEEE 1394 (a.k.a. Firewire), infrared interface, IEEE 802.15, Bluetooth™ and the like. Again the present invention is independent of the interface selected. Media data is then stored on the storage device such as, disk drive 230 in accordance with processor 300. Disk drive 230 is preferably a miniature drive with a capacity of 1 Gbyte of data storage, which is particularly suitable for a portable device. Of course, any other appropriate sized disk drive may be employed.

Alternatively, media data may be obtained directly from an external analog source, such as a microphone or video camera, connected to input 214. Input 214 takes the input signal from external device and sets the analog signal to an appropriate level. The analog signal is then converted to a digital signal and compressed using a

selected format by processor 300, as will be described hereinbelow. The compressed digital data is similarly stored on disk drive 230.

When the user chooses a selection of media data to be played back with keypad 208, processor 300 powers up disk drive 230 and retrieves the selected data which is then transferred to memory 202. It is noted that the powering up of the device is done in a sequential manner so as to minimize energy consumption of the device. A more detailed description is provided below.

Memory 202 comprises a solid state memory, such as, for example dynamic random access memory (solid state memory), flash memory, EEPROM, or the like. It is not necessary for memory 202 to be nonvolatile since the media data is stored in a nonvolatile manner on storage device or disk drive 230. The quantity of solid state memory required is less than is required in a conventional MP3 player. The quantity of solid state memory contemplate is about 2 Mbytes, which is sufficient to store about 2 minutes of MP3 data. Of course, as will be appreciated by one of ordinary skill in the art, when dealing with video data, more solid state memory may be required. The amount of solid state memory supplied is selected to minimize energy consumption.

After the selected data is stored in memory 202, disk drive 230 is then powered down. In this manner, during playback disk drive 230 is only powered up only during the transfer of the selected media data from disk drive 230 to memory 202, which results in lower energy consumption. A more detailed description of the powering down of disk drive 230 is provided herein below. The media data is retrieved from memory 202. Processor 300 determines the format of data compression from the retrieved data. Disk drive 230, also stores the data compression/decompression algorithms. The data is decompressed in accordance with the determined format and converted to an analog signal by processor 300. The analog signal is set to an appropriate level by output circuit 216. If the analog signal contains audio data, output circuit 216 is connected to a speaker, headphone and the like for playback, and if the analog signal contains video data, output circuit 216 is connected to a display device for playback.

Additionally, media data recorded on disk drive 230 or stored in memory 202 may be transferred (uploaded) to a personal computer, network appliance, local area network, internet 50 or another media player/recorder through interface 206 under the control of processor 300.

FIG. 3 is a detailed block diagram of processor 300. Processor 300 is preferably implemented as a single integrated circuit. A media playback/recorder apparatus having a processor implemented as a single integrated circuit can be fabricated at lower cost and have lower energy consumption. Alternatively, processor 300 may be implemented by discrete components. Processor 300 comprises a read channel 341, storage controller or hard disk controller 342, digital signal processor/microprocessor unit (DSP/MPU) 343, random access memory (RAM) 344, a non volatile memory such as read only memory (ROM) 345, digital to analog converter (DAC) 346 and analog to digital converter (ADC) 347. DSP/MPU 343 comprises servo controller 349 and Codec 348. In the preferred embodiment, DSP/MPU 343 is implemented as a single integrated circuit. In another embodiment, MPU may be implemented as one integrated circuit and the DSP may be implemented as another integrated circuit.

It is noted that DSP/MPU 344 may comprise a microprocessor unit, a digital signal processor or combination thereof. ROM 345 stores programmed instructions for processor 300 and DSP/MPU 343 to control the operation of both the disk drive 230 (and associated circuitry) and the signal processing of the media data. RAM 345 is provided as a working memory for DSP/MPU 343. For each of the various compression formats discussed above, the decompression and compression algorithms for Codec 348 are stored on disk drive 230. Storing the decompression and compression algorithms on disk drive 230 minimizes the size of ROM 344 and its energy consumption. Additionally, this feature allows future compression and decompressions formats to be easily implemented for the media player/recorder.

Prior to discussing the operation of processor 300, reference is made to Fig 6. FIG. 6 shows an exemplary data format of a magnetic media used, in disk drive 230, comprising a series of concentric data tracks 13 wherein each data track 13 comprises a plurality of sectors 15 with embedded servo wedges 17. Servo controller 349 processes the servo data in servo wedges 17 and, in response thereto, positions the read/write head over a desired track. Additionally, servo controller 349 processes servo bursts within servo wedges 17 to keep a disk head of disk drive 230 aligned over a centerline of the desired track while writing and reading data. Servo wedges 17 may be detected by the discrete time sequence detector implemented in DSP/MPU 343. It is important to note that DSP/MPU 343 is utilized only during the time period for detecting servo wedges 17, during other periods DSP/MPU 343 is available to perform other functions as described below, such as signal processing for media data playback

and recording. By using only one DSP rather than two, the cost of fabrication can be reduced and the amount of energy consumption can also be reduced.

As described above, the powering up of the device is done in a sequential manner so as to minimize energy consumption of the device. More specifically, the mechanical or motor portions of the storage device are energized first. After the motor reaches operating speed, VCM 234 is energized, followed by the energization of read channel 341 and HDC 342.

The operation of processor 300 is as follows. DSP/MPU 343 controls the entire operation of the media player/recorder. DSP/MPU 343 is coupled to hard disk controller 342. When writing data to disk drive 230, hard disk controller 342 receives a write instruction and write data from DSP/MPU 343. The write data is temporarily stored in a cache memory (not shown) which is used as a buffer memory. Based on a clock from a clock generator (not shown), DSP/MPU 343 controls voice coil motor (VCM) and spindle motor 234 via servo unit 349. As a result, the magnetic head is moved to a desired track position on the magnetic disk by the head arm, and the magnetic disk is rotated at a rated rotational speed by the spindle, which is driven by spindle motor 234. The data is read from the cache memory and supplied to read channel 341 via hard disk controller 342. Read channel 341 encodes the write data under the control of DSP/MPU 343, and supplies the encoded write data to preamplifier 232. The magnetic head writes the encoded write data on the magnetic disk in accordance with a signal from preamplifier 232.

When reading data from the magnetic disk, hard disk controller 342 receives a read instruction from DSP/MPU 343. Based on a clock signal, DSP/MPU 343 controls voice coil motor and spindle motor 234 via servo unit 349. Hence, the magnetic head is moved to a desired track position on the magnetic disk by the head arm, and the magnetic disk is rotated by spindle motor 234.

The data read from the magnetic disk by the magnetic head is supplied to read channel 341 via preamplifier 232. Read channel 341 decodes the read data under the control of DSP/MPU 343, and generates read data. The read data are supplied from read channel 341 to hard disk controller 342 under the control of DSP/MPU 343, and are temporarily stored in the cache memory. The read data read from the cache memory are supplied to DSP/MPU 343 from hard disk controller 342.

As noted above, operation of the media player/recorder is controlled by the user through keypad 208, which is in communication with DSP/MPU 343. Status of the

media player/recorder is provided to the user by display 212 in accordance with DSP/MPU 343. When either uploading or downloading data, the media player/recorder is in communication with personal computer, network appliance, local area network, Internet 50. Otherwise the media player/recorder can be operated independently. The user selects the file to be downloaded from personal computer, network appliance, local area network, Internet 50 by way of keypad 208. Alternatively the user can select the file to be downloaded from the personal computer. DSP/MPU 343 controls the flow of data interface 206 and stores the data onto hard disk 230 in accordance with the method described above. When uploading data to personal computer, network appliance, local area network, Internet 50 the process is reversed.

To record data directly input into media player/recorder from an external analog source, the external device is placed in communication with input 214. Input 214 takes the input signal from external device and sets the analog signal to an appropriate level. The analog signal is then converted to a digital signal by ADC 347 of processor 300. Codec 348 of DSP/MPU 343 compresses the digitized data using a default compression format or one selected by the user by way of keypad 208. The default or selected compression program is transferred from hard disk 230 to RAM 344 and provided to Codec 348 for encoding. The compressed digital data is similarly stored on disk drive 230 under the control of DSP/MPU 343.

When the user chooses a selection of media data to be played back with keypad 208, DSP/MPU 343 powers up disk drive 230 and retrieves the selected data as described above. The retrieved data is then written to memory 202. After the selected data is stored in memory 202, disk drive 230 is then powered down by DSP/MPU 343. In this manner, during playback disk drive 230 is powered up only during the transfer of the selected media data from disk drive 230 to memory 202, which results in lower energy consumption. A single song stored in MP3 format may take approximately one second to retrieve from disk drive 230. The media data is retrieved from memory 202 by DSP/MPU 343 and the compression format is then determined.

If the decompression program has already been transferred to RAM 344, the program is provided to Codec 348. Otherwise the decompression algorithm is retrieved from hard disk 230 and transferred to RAM 344. The data is then decompressed by Codec 348 and converted to an analog signal by DAC 346. The analog signal is set to an appropriate level by output circuit 216. If the analog signal contains audio data, output circuit 216 is connected to a speaker, headphone and the like for playback, and

if the analog signal contains video data, output circuit 216 is connected to a display device for playback.

It is noted that the capacity of disk drive 230 is selected to hold a desired amount of media data, and the amount of solid state memory 202 is selected to minimize energy consumption. A disk drive having a capacity of 1 Gbyte can store approximately 30 hours of MP3 compressed music.

This section will described the power management control of the device by CPU/MPU 343.

Referring now to Figs. 3, 7 and 9. When the user turns on the media player and selects a file to be played (step 912), the various components of media player are powered up in a sequential manner so as to minimize energy consumption of the device. More specifically, the mechanical or motor portions of the storage device or disk drive 230 are energized first (step 914). After the motor reaches its operating speed (step 916), VCM 234, preamp 332, read channel 341 and HDC 342 are energized, since these components are only functional after disk drive 230 becomes operational. Energy would be unnecessarily expended if preamp 332, read channel 341 and HDC 342 were energized before disk drive 230 becomes operational. Therefore, VCM 234, preamp 332, read channel 341 and HDC 342 are energized only after disk drive 230 becomes operational (step 918). Preamp 332, read channel 341 and HDC 342 can be referred to as a storage circuit and include circuits to transform data stored on a storage device to a digital signal.

Fig. 7 is a schematic representation of memory 202. User data is first stored from location 724 to location 702 in a sequential manner in memory 202. In one embodiment, DSP/MPU 343 uses a pointer system in connection with memory 202 to determine when the amount of data stored the amount data stored reaches an upper threshold value (step 922). When the amount of data stored in memory 202 reaches the upper threshold value, HDC 342, read channel 341, preamp 332, disk drive 230 and VCM 334 are powered down or deenergized (step 924). Of course, as will be appreciated by one of ordinary skill in the art, while data is being to memory 202, data may also be read contemporaneously therefrom by DSP/MPU 343 for decompression and playback. Data is then read out from memory 202 starting at location 702 towards location 724 by DSP/MPU 343 (step 926). When the data file has been completely read from memory (step 928), the user can select another file. The data is continually read from memory 202, until the amount of data remaining is below a low threshold value

(step 930). When the data remaining in memory 202 is below the threshold value, disk drive 230, VCM 334, preamp 332, read channel 341 and HDC 342 are sequentially energized as noted above, and data is transferred from the storage device to memory 202.

Fig. 10, is an alternate embodiment to Fig. 9. Instead of utilizing a pointer system, the amount of data transferred to memory 202 is counted (step 1020) by a counter incorporated in DSP/MPU 343. The sequential energization of the disk drive 230, VCM 334, preamp 332, read channel 341 and HDC 342 is similar to that of the embodiment of Fig. 9 (steps 1012, 1014, 1016 and 1018). When amount of data transfer to memory 202 is greater than or equal to an upper limit U (step 1022), HDC 342, read channel 341, preamp 332, disk drive 230 and VCM 334 are powered down or deenergized (step 1024). As data is read from memory, the counter decrements the count, and when the count is less than or equal to a lower limit l (step 1030), disk drive 230, VCM 334, preamp 332, read channel 341 and HDC 342 are sequentially energized as noted above, and data is transferred from the storage device to memory 202.

Fig. 11 is another alternate embodiment to Fig. 9. The embodiment in Fig. 9 utilizes a timer incorporated in DSP/MPU 343 to approximate the amount of data transferred to memory 202 in accordance with the data transfer rate of disk drive 230. The sequential energization of disk drive 230, VCM 334, preamp 332, read channel 341 and HDC 342 is similar to that of the embodiment of Fig. 9 (steps 1112, 1114, 1116 and 1118). The timer is started (step 1119) as data is transferred form disk drive 230 to memory 202. When the timer times out, HDC 342, read channel 341, preamp 332, disk drive 230 and VCM 334 are powered down or deenergized (step 1124). As data is read from memory, the timer is started (1125), and when the timer times out (step 1130), disk drive 230, VCM 334, preamp 332, read channel 341 and HDC 342 are sequentially energized as noted above, and data is transferred from the storage device to memory 202.

In the simplest implementation, media data representing one selection (such as a single song) is transferred from disk drive 230 to memory 202 for playback. Fig. 8 is a schematic representation of memory 202, and Fig. 12 is a flow chart illustrating an alternate implementation. As shown therein, instead of retrieving just one selection, first portions of multiple selections are transferred from disk drive 230 to memory 202. These multiple selections may include the user's favorite selections, random selections from an external source, or the like (step 1204). When the user starts playing back the selection, a timer is started (step 1208) and the first selection is played back (step

1210). If a user instruction is received (step 1212) to continue playing that selection is received within a predetermined time (step 1214), the remaining portion of the selection is transferred from disk drive 230 to memory 202 (step 1216) for continued play back (step 1218). If the timer times out (step 1214), the first portion of the next selection (step 1206) is played back and the process is repeated for each remaining first portion. Alternatively, instead of using a timer, a memory threshold, as shown in Fig 8, may be utilized permit playback of the entire current selection if the user instruction is received before the memory being read out goes below the current selection threshold. Otherwise the first portion of the next selection is played back. Of course, the play back of portions of selections 1 through N may be in any order, such as sequential, random and predetermined. If the play back is in sequential order new selections may be transferred from disk drive 230 to memory 202 to replace previously played back selections.

Figs. 4 and 5 show a second embodiment of the present invention. The second embodiment is similar to the first embodiment except the second embodiment does not include memory 202. This embodiment media data is recorded thereon in a similar manner as the first embodiment and no further discussion is provided herein. For playback operation, the media data is retrieved directly from disk drive 230 for playback through output 216. The other portions of the playback operation are similar to the first embodiment. In the second embodiment disk drive 230 will be powered on any time media data is recorded or played back. As such this embodiment is particularly applicable when the power supply is external. For example the media player/recorder of the second embodiment may be a portable device used in an automobile supply by energy therefrom.

While the invention has been described in conjunction with several specific embodiments, it is evident to those skilled in the art that many further alternatives, modifications and variations will be apparent in light of the foregoing description. Thus, the invention described herein is intended to embrace all such alternatives, modifications, applications and variations as may fall within the spirit and scope of the appended claims.

WHAT IS CLAIMED IS:

1. A media player/recorder comprising:

a storage device to store compressed media data;

a processor to retrieve the media data stored in said storage device;

a memory to store the media data retrieved by said processor,

wherein said processor decompresses the media data stored in said memory; and

an output circuit to output the decompressed media data from said processor.

2. A media player/recorder according to claim 1, wherein said memory comprises a dynamic access memory.

3. A media player according to claim 1, further comprising an interface responsive to said processor to communicate with an external device.

4. A media player according to claim 1, wherein said processor comprises a digital signal processor to control said storage device and to decompress the media data stored in said memory.

5. A media player according to claim 1, wherein said processor comprises a single integrated circuit comprising:

a digital signal processor to control said storage device and to decompress the media data stored in said memory;

a storage controller responsive to said digital signal processor; and

a read channel to read data from said storage device and responsive to said storage controller.

6. A media player according to claim 4, wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory.

7. A media player according to claim 6, wherein said storage device stores a process for decompressing compressed data for a selected compression format.

8. A media player according to claim 7, wherein said digital signal processor determines a compression format of the media data stored in said memory, wherein the process for decompressing compressed data is retrieved from said storage device in accordance with the determined compression format, and wherein said decoder decompresses the media data in accordance with the retrieved process.

9. A media player according to claim 3, wherein the media data is transferred from the external device through said interface for storage on said storage device.

10. A media player according to claim 4, further comprising an input circuit to receive media data, wherein said digital signal processor comprises an encoder to compress the received media data, and wherein the compress media data received by said input circuit is stored on said storage device.

11. A media player/recorder comprising:

a storage device to store compressed media data;

a processor to retrieve the media data stored in said storage device;

wherein said processor decompresses the media data stored in said storage device; and

an output circuit to output the decompressed media data from said processor,

wherein said processor comprises a digital signal processor to control said storage device and to decompress the media data stored in said memory.

12. A media player/recorder according to claim 11, wherein said memory comprises a dynamic access memory.

13. A media player according to claim 11, further comprising an interface responsive to said processor to communicate with an external device.

14. A media player according to claim 11, wherein said processor comprises a single integrated circuit comprising:

a digital signal processor to control said storage device and to decompress the media data stored in said memory;

a storage controller responsive to said digital signal processor; and

a read channel to read data from said storage device and responsive to said storage controller.

15. A media player according to claim 11, wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory.

16. A media player according to claim 15, wherein said storage device stores a process for decompressing compressed data for a selected compression format.

17. A media player according to claim 16, wherein said digital signal processor determines a compression format of the media data stored in said memory, wherein the process for decompressing compressed data is retrieved from said storage device in accordance with the determined compression format, and wherein said decoder decompresses the media data in accordance with the retrieved process.

18. A media player according to claim 13, wherein the media data is transferred from the external device through said interface for storage on said storage device.

19. A media player according to claim 11, further comprising an input circuit to receive media data, wherein said digital signal processor comprises an encoder to compress the received media data, and wherein the compress media data received by said input circuit is stored on said storage device.

20. An integrated circuit to control a media player/recorder having a storage device having stored thereon compressed media data, a memory and an output circuit, said integrated circuit comprising:

a digital signal processor to control the storage device;

a storage controller responsive to said digital signal processor; and

a read channel responsive to said storage controller to read the compressed media data from the storage device,

wherein said digital signal processor transfers the compressed media data read by said read channel to the memory,

wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory; and

wherein said digital signal processor converts the media data decompressed by said decoder to an analog signal.

21. A media player according to claim 20,

wherein the storage device stores a process for decompressing compressed data for a selected compression format,

wherein said digital signal processor determines a compression format of the media data stored in the memory, wherein the process for decompressing compressed data is retrieved from the storage device in accordance with the determined compression format, and wherein said decoder decompresses the media data in accordance with the retrieved process.

22. A method of playing and recording media data from a media player/recorder, said method comprising the steps of:

a. storing compressed media data on a storage device;

b. retrieving the compressed media data stored on the storage device;

c. transferring the compressed media data retrieved in step b to a memory;

d. decompressing the compressed media data transferred in step c; and

e. outputting the decompressed media data.

23. A method of claim 22, wherein step a comprises the step of communication with an external device.

24. A method of claim 22, further comprising the step of supplying energy to the storage device only during step a or step b.

25. A method of claim 22, further comprising the steps of:

f. storing a process for decompressing compressed data for a selected compression format;

g. determining a compression format of the media data transferred in step c;

h. retrieving the selected compression format stored in step f; and

i. decompressing the compressed media data transferred in step c in accordance with the retrieved selected compression format in step h.

26. A method of claim 22 further comprising the steps of:

j. inputting a signal;

k. compressing the signal input in step j; and

l. storing the compressed signal from step k on the storage device.

27. A media player according to claim 1, wherein energy is supplied to said storage device only when said processor retrieves the media data from said storage device.

28. A media player/recorder comprising:

storage means for storing compressed media data;

processing means for retrieving the media data stored in said storage means;

memory means for storing the media data retrieved by said processing means,

wherein said processing means decompresses the media data stored in said memory means; and

output means for outputting the decompressed media data from said processing means.

29. A media player/recorder according to claim 28, wherein said memory means comprises a dynamic access memory means.

30. A media player according to claim 28, further comprising interface means responsive to said processing means for communicating with an external device.

31. A media player according to claim 28, wherein said processing means comprises digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means.

32. A media player according to claim 28, wherein said processing means comprises a single integrated circuit comprising:

digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means;

storage controller means responsive to said digital signal processing means for controlling said storage means; and

read channel means for reading data from said storage means and responsive to said storage controller means.

33. A media player according to claim 31, wherein said digital signal processing means comprises a decoding means for decompressing the media data stored in said memory means.

34. A media player according to claim 33, wherein said storage means stores a process for decompressing compressed data for a selected compression format.

35. A media player according to claim 34, wherein said digital signal processing means determines a compression format of the media data stored in said memory means, wherein the process for decompressing compressed data is retrieved from said storage means in accordance with the determined compression format, and wherein said decoding means decompresses the media data in accordance with the retrieved process.

36. A media player according to claim 30, wherein the media data is transferred from the external device through said interface means for storage on said storage means.

37. A media player according to claim 31, further comprising input means for receiving media data, wherein said digital signal processing means comprises encoding means for compressing the received media data, and wherein the compress media data received by said input means is stored on said storage means.

38. A media player/recorder comprising:

storage means for storing compressed media data;

processing means for retrieving the media data stored in said storage means;

wherein said processing means decompresses the media data stored in said storage means; and

output means for outputting the decompressed media data from said processing means,

wherein said processing means comprises a digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means.

39. A media player/recorder according to claim 38, wherein said memory means comprises a dynamic access memory means.

40. A media player according to claim 38, further comprising an interface means responsive to said processing means for communicating with an external device.

41. A media player according to claim 38, wherein said processing means comprises a single integrated circuit comprising:

digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means;

storage controller means responsive to said digital signal processing means for controlling said storage device; and

read channel means for reading data from said storage means and responsive to said storage controller means.

42. A media player according to claim 38, wherein said digital signal processing means comprises decoding means for decompressing the media data stored in said memory means.

43. A media player according to claim 42, wherein said storage means stores a process for decompressing compressed data for a selected compression format.

44. A media player according to claim 43, wherein said digital signal processing means determines a compression format of the media data stored in said memory means, wherein the process for decompressing compressed data is retrieved from said storage means in accordance with the determined compression format, and wherein said decoding means decompresses the media data in accordance with the retrieved process.

45. A media player according to claim 40, wherein the media data is transferred from the external device through said interface means for storage on said storage means.

46. A media player according to claim 38, further comprising input means for receiving media data, wherein said digital signal processing means comprises encoding means for compressing the received media data, and wherein the compress media data received by said input means is stored on said storage means.

47. An integrated circuit for controlling a media player/recorder having storage means having stored thereon compressed media data, memory means and output means, said integrated circuit comprising:

digital signal processing means for controlling the storage means;

storage controller means responsive to said digital signal processing means; and

read channel means responsive to said storage controller means for reading the compressed media data from the storage means,

wherein said digital signal processing means transfers the compressed media data read by said read channel means to the memory means,

wherein said digital signal processing means comprises a decoding means for decompressing the media data stored in said memory means; and

wherein said digital signal processing means converts the media data decompressed by said decoding means to an analog signal.

48. A media player according to claim 47,

wherein the storage means stores a process for decompressing compressed data for a selected compression format,

wherein said digital signal processing means determines a compression format of the media data stored in the memory means, wherein the process for decompressing compressed data is retrieved from the storage means in accordance with the determined compression format, and wherein said decoding means decompresses the media data in accordance with the retrieved process.

49. A media player/recorder comprising:

a storage device to store compressed media data;

a processor to retrieve the media data stored in said storage device;

a memory to store the media data retrieved by said processor,

wherein said processor decompresses the media data stored in said memory; and

an output circuit to output the decompressed media data from said processor.

50. A media player/recorder according to claim 1, wherein said memory comprises a dynamic access memory.

51. A media player according to claim 1, further comprising an interface responsive to said processor to communicate with an external device.

52. A media player according to claim 1, wherein said processor comprises a digital signal processor to control said storage device and to decompress the media data stored in said memory.

53. A media player according to claim 1, wherein said processor comprises a single integrated circuit comprising:

a digital signal processor to control said storage device and to decompress the media data stored in said memory;

a storage controller responsive to said digital signal processor; and

a read channel to read data from said storage device and responsive to said storage controller.

54. A media player according to claim 4, wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory.

55. A media player according to claim 6, wherein said storage device stores a process for decompressing compressed data for a selected compression format.

56. A media player according to claim 7, wherein said digital signal processor determines a compression format of the media data stored in said memory, wherein the process for decompressing compressed data is retrieved from said storage device in accordance with the determined compression format, and wherein said decoder decompresses the media data in accordance with the retrieved process.

57. A media player according to claim 3, wherein the media data is transferred from the external device through said interface for storage on said storage device.

58. A media player according to claim 4, further comprising an input circuit to receive media data, wherein said digital signal processor comprises an encoder to compress the received media data, and wherein the compress media data received by said input circuit is stored on said storage device.

59. A media player/recorder comprising:

a storage device to store compressed media data;

a processor to retrieve the media data stored in said storage device;

wherein said processor decompresses the media data stored in said storage device; and

an output circuit to output the decompressed media data from said processor,

wherein said processor comprises a digital signal processor to control said storage device and to decompress the media data stored in said memory.

60. A media player/recorder according to claim 11, wherein said memory comprises a dynamic access memory.

61. A media player according to claim 11, further comprising an interface responsive to said processor to communicate with an external device.

62. A media player according to claim 11, wherein said processor comprises a single integrated circuit comprising:

said digital signal processor to control said storage device and to decompress the media data stored in said memory;

a storage controller responsive to said digital signal processor; and

a read channel to read data from said storage device and responsive to said storage controller.

63. A media player according to claim 11, wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory.

64. A media player according to claim 15, wherein said storage device stores a process for decompressing compressed data for a selected compression format.

65. A media player according to claim 16, wherein said digital signal processor determines a compression format of the media data stored in said memory, wherein

the process for decompressing compressed data is retrieved from said storage device in accordance with the determined compression format, and wherein said decoder decompresses the media data in accordance with the retrieved process.

66. A media player according to claim 13, wherein the media data is transferred from the external device through said interface for storage on said storage device.

67. A media player according to claim 11, further comprising an input circuit to receive media data, wherein said digital signal processor comprises an encoder to compress the received media data, and wherein the compress media data received by said input circuit is stored on said storage device.

68. An integrated circuit to control a media player/recorder having a storage device having stored thereon compressed media data, a memory and an output circuit, said integrated circuit comprising:

a digital signal processor to control the storage device;

a storage controller responsive to said digital signal processor; and

a read channel responsive to said storage controller to read the compressed media data from the storage device,

wherein said digital signal processor transfers the compressed media data read by said read channel to the memory,

wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory; and

wherein said digital signal processor converts the media data decompressed by said decoder to an analog signal.

69. An integrated circuit according to claim 68,

wherein the storage device stores a process for decompressing compressed data for a selected compression format,

wherein said digital signal processor determines a compression format of the media data stored in the memory, wherein the process for decompressing compressed data is retrieved from the storage device in accordance with the determined compression format, and wherein said decoder decompresses the media data in accordance with the retrieved process.

70. A method of playing and recording media data from a media player/recorder, said method comprising the steps of:

a. storing compressed media data on a storage device;

b. retrieving the compressed media data stored on the storage device;

c. transferring the compressed media data retrieved in step b to a memory;

d. decompressing the compressed media data transferred in step c; and

e. outputting the decompressed media data.

71. A method of claim 70, wherein step a comprises the step of communication with an external device.

72. A method of claim 70, further comprising the step of supplying energy to the storage device only during step a or step b.

73. A method of claim 70, further comprising the steps of:

f. storing a process for decompressing compressed data for a selected compression format;

g. determining a compression format of the media data transferred in step c;

h. retrieving the selected compression format stored in step f; and

i. decompressing the compressed media data transferred in step c in accordance with the retrieved selected compression format in step h.

74. A method of claim 70, further comprising the steps of:

j. inputting a signal;

k. compressing the signal input in step j; and

l. storing the compressed signal from step k on the storage device.

75. A media player according to claim 1, wherein energy is supplied to said storage device only when said processor retrieves the media data from said storage device.

76. A media player/recorder comprising:

storage means for storing compressed media data;

processing means for retrieving the media data stored in said storage means;

memory means for storing the media data retrieved by said processing means,

wherein said processing means decompresses the media data stored in said memory means; and

output means for outputting the decompressed media data from said processing means.

77. A media player/recorder according to claim 28, wherein said memory means comprises a dynamic access memory means.

78. A media player according to claim 28, further comprising interface means responsive to said processing means for communicating with an external device.

79. A media player according to claim 28, wherein said processing means comprises digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means.

80. A media player according to claim 28, wherein said processing means comprises a single integrated circuit comprising:

digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means;

storage controller means responsive to said digital signal processing means for controlling said storage means; and

read channel means for reading data from said storage means and responsive to said storage controller means.

81. A media player according to claim 31, wherein said digital signal processing means comprises a decoding means for decompressing the media data stored in said memory means.

82. A media player according to claim 33, wherein said storage means stores a process for decompressing compressed data for a selected compression format.

83. A media player according to claim 34, wherein said digital signal processing means determines a compression format of the media data stored in said memory means, wherein the process for decompressing compressed data is retrieved from said storage means in accordance with the determined compression format, and wherein said decoding means decompresses the media data in accordance with the retrieved process.

84. A media player according to claim 30, wherein the media data is transferred from the external device through said interface means for storage on said storage means.

85. A media player according to claim 31, further comprising input means for receiving media data, wherein said digital signal processing means comprises encoding means for compressing the received media data, and wherein the compress media data received by said input means is stored on said storage means.

86. A media player/recorder comprising:

storage means for storing compressed media data;

processing means for retrieving the media data stored in said storage means;

wherein said processing means decompresses the media data stored in said storage means; and

output means for outputting the decompressed media data from said processing means,

wherein said processing means comprises a digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means.

87. A media player/recorder according to claim 38, wherein said memory means comprises a dynamic access memory means.

88. A media player according to claim 38, further comprising an interface means responsive to said processing means for communicating with an external device.

89. A media player according to claim 38, wherein said processing means comprises a single integrated circuit comprising:

digital signal processing means for controlling said storage means and for decompressing the media data stored in said memory means;

storage controller means responsive to said digital signal processing means for controlling said storage device; and

read channel means for reading data from said storage means and responsive to said storage controller means.

90. A media player according to claim 38, wherein said digital signal processing means comprises decoding means for decompressing the media data stored in said memory means.

91. A media player according to claim 42, wherein said storage means stores a process for decompressing compressed data for a selected compression format.

92. A media player according to claim 43, wherein said digital signal processing means determines a compression format of the media data stored in said memory means, wherein the process for decompressing compressed data is retrieved from said storage means in accordance with the determined compression format, and wherein said decoding means decompresses the media data in accordance with the retrieved process.

93. A media player according to claim 40, wherein the media data is transferred from the external device through said interface means for storage on said storage means.

94. A media player according to claim 38, further comprising input means for receiving media data, wherein said digital signal processing means comprises encoding means for compressing the received media data, and wherein the compress media data received by said input means is stored on said storage means.

95. An integrated circuit for controlling a media player/recorder having storage means having stored thereon compressed media data, memory means and output means, said integrated circuit comprising:

digital signal processing means for controlling the storage means;

storage controller means responsive to said digital signal processing means; and

read channel means responsive to said storage controller means for reading the compressed media data from the storage means,

wherein said digital signal processing means transfers the compressed media data read by said read channel means to the memory means,

wherein said digital signal processing means comprises a decoding means for decompressing the media data stored in said memory means; and

wherein said digital signal processing means converts the media data decompressed by said decoding means to an analog signal.

96. A integrated circuit according to claim 95,

wherein the storage means stores a process for decompressing compressed data for a selected compression format,

wherein said digital signal processing means determines a compression format of the media data stored in the memory means, wherein the process for decompressing compressed data is retrieved from the storage means in accordance with the determined compression format, and wherein said decoding means decompresses the media data in accordance with the retrieved process.

97. A media player/recorder according to claim 1, wherein said storage device comprises a hard disk.

98. A media player/recorder according to claim 1, wherein said storage device is selected from the group consisting of optical disk, magnetic disk, CD ROM, CDR, and CDRW.

99. A media player/recorder according to claim 5, wherein said storage device comprises a hard disk, and wherein said storage controller comprises a hard disk controller.

100. A media player/recorder according to claim 11, wherein said storage device comprises a hard disk.

101. A media player/recorder according to claim 11, wherein said storage device is selected from the group consisting of optical disk, magnetic disk, CD ROM, CDR, and CDRW.

102. A media player/recorder according to claim 14, wherein said storage device comprises a hard disk, and wherein said storage controller comprises a hard disk controller.

103. An integrated circuit according to claim 20, wherein the storage device comprises a hard disk, and wherein said storage controller comprises a hard disk controller.

104. A method according to claim 22, wherein the storage device comprises a hard disk.

105. A method according to claim 22, wherein the storage device is selected from the group consisting of optical disk, magnetic disk, CD ROM, CDR, and CDRW.

106. A media player/recorder according to claim 28, wherein said storage means comprises hard disk means.

107. A media player/recorder according to claim 28, wherein said storage means is selected from the group consisting of optical storage means, magnetic storage means, CD ROM, CDR, and CDRW.

108. A media player/recorder according to claim 32, wherein said storage means comprises hard disk means, and wherein said storage controller means comprises hard disk controller means.

109. A media player/recorder according to claim 38, wherein said storage means comprises hard disk means.

110. A media player/recorder according to claim 38, wherein said storage means is selected from the group consisting of optical storage means, magnetic storage means, CD ROM, CDR, and CDRW.

111. A media player/recorder according to claim 41, wherein said storage means comprises hard disk means, and wherein said storage controller means comprises hard disk controller means.

112. An integrated circuit according to claim 47, wherein the storage means comprises hard disk means, and wherein said storage controller means comprises hard disk controller means.

113. A media player/recorder comprising:

a storage device to store media data;

a storage circuit responsive to said storage device;

a processor to retrieve the media data stored in said storage device responsive to said storage circuit;

a memory to store the media data retrieved by said processor,

wherein said processor controls energization and deenerization of said storage device and said storage circuit in accordance with the media data stored in said memory.

114. A media player/recorder according to Claim 113, wherein the said processor energizes said storage device prior to energizing said storage circuit.

115. A media player/recorder according to Claim 113, wherein the said processor deenergizes said storage device and said storage circuit when an amount of the media data stored in said memory is at least a first predetermined value.

116. A media player/recorder according to Claim 115, wherein the said processor energizes said storage device prior to energizing said storage circuit when an amount of the media data stored in said memory goes below a second predetermined value.

117. A media player/recorder according to Claim 113, wherein said processor comprises a counter to count an amount of data transferred to and from said memory.

118. A media player/recorder according to Claim 117, wherein the said processor deenergizes said storage device and said storage circuit when the count of the media data stored in said memory is at least a first predetermined value.

119. A media player/recorder according to Claim 118, wherein the said processor energizes said storage device prior to energizing said storage circuit when the count of the media data stored in said memory goes below a second predetermined value.

120. A media player/recorder according to Claim 113, said processor comprises a timer to determine a first time when data is transferred to said memory and a second time when data is transferred from said memory.

121. A media player/recorder according to Claim 120, wherein the said processor deenergizes said storage device and said storage circuit when the first time is at least a first predetermined value.

122. A media player/recorder according to Claim 121, wherein the said processor energizes said storage device prior to energizing said storage circuit when second time is at least a second predetermined value.

123. An integrated circuit to control a media player/recorder having a storage device having stored thereon media data, a storage circuit, a memory and an output circuit, said integrated circuit comprising:

a digital signal processor to control the storage device and storage circuit;

a storage controller responsive to said digital signal processor; and

wherein said digital signal processor transfers the media data read by the storage circuit to the memory,

wherein said digital signal processor comprises a decoder to decompress the media data stored in said memory; and

wherein said processor controls energization and deenerization of said storage device and said storage circuit in accordance with the media data stored in said memory.

124. An integrated circuit according to Claim 123, wherein the said processor energizes the storage device prior to energizing the storage circuit.

125. An integrated circuit according to Claim 123, wherein the said processor deenergizes the storage device and the storage circuit when an amount of the media data stored in said memory is at least a first predetermined value.

126. An integrated circuit according to Claim 125, wherein the said processor energizes the storage device prior to energizing the storage circuit when an amount of the media data stored in the memory goes below a second predetermined value.

127. An integrated circuit according to Claim 123, wherein said processor comprises a counter to count an amount of data transferred to and from the memory.

128. An integrated circuit according to Claim 127, wherein the said processor deenergizes the storage device and the storage circuit when the count of the media data stored in the memory is at least a first predetermined value.

129. An integrated circuit according to Claim 128, wherein the said processor energizes the storage device prior to energizing the storage circuit when the count of the media data stored in the memory goes below a second predetermined value.

130. An integrated circuit according to Claim 123, said processor comprises a timer to determine a first time when data is transferred to said memory and a second time when data is transferred from said memory.

131. An integrated circuit according to Claim 130, wherein the said processor deenergizes the storage device and the storage circuit when the first time is at least a first predetermined value.

132. An integrated circuit according to Claim 131, wherein the said processor energizes said storage device prior to energizing said storage circuit when second time is at least a second predetermined value.

133. A media player/recorder comprising:

storage means for storing media data;

storage circuit means for processing the media data stored on said storage means;

processor means for retrieving the media data stored in said storage means responsive to said storage circuit means;

memory means for storing the media data retrieved by said processor means,

wherein said processor means controls energization and deenerization of said storage means and said storage circuit means in accordance with the media data stored in said memory means.

134. A media player/recorder according to Claim 133, wherein the said processor means energizes said storage means prior to energizing said storage circuit means.

135. A media player/recorder according to Claim 133, wherein the said processor means deenergizes said storage means and said storage circuit means when an amount of the media data stored in said memory means is at least a first predetermined value.

136. A media player/recorder according to Claim 135, wherein the said processor means energizes said storage means prior to energizing said storage circuit means when an amount of the media data stored in said memory means goes below a second predetermined value.

137. A media player/recorder according to Claim 133, wherein said processor means comprises counting means to count an amount of data transferred to and from said memory means.

138. A media player/recorder according to Claim 137, wherein the said processor means deenergizes said storage means and said storage circuit means when the count of the media data stored in said memory means is at least a first predetermined value.

139. A media player/recorder according to Claim 138, wherein the said processor means energizes said storage means prior to energizing said storage circuit means when the count of the media data stored in said memory means goes below a second predetermined value.

140. A media player/recorder according to Claim 133, said processor means comprises timing means for determining a first time when data is transferred to said memory means and a second time when data is transferred from said memory means.

141. A media player/recorder according to Claim 140, wherein the said processor means deenergizes said storage means and said storage circuit means when the first time is at least a first predetermined value.

142. A media player/recorder according to Claim 141, wherein the said processor means energizes said storage means prior to energizing said storage circuit means when second time is at least a second predetermined value.

143. An integrated circuit to control a media player/recorder having a storage device having stored thereon media data, a storage circuit, a memory and an output circuit, said integrated circuit comprising:

digital signal processor means to control the storage device and storage circuit;

storage control means responsive to said digital signal processor means; and

wherein said digital signal processor means transfers the media data read by the storage circuit means to the memory means,

wherein said digital signal processor means comprises a decoder to decompress the media data stored in said memory means; and

wherein said processor means controls energization and deenerization of said storage device and said storage circuit in accordance with the media data stored in said memory means.

144. An integrated circuit according to Claim 143, wherein the said processor means energizes the storage device prior to energizing the storage circuit means.

145. An integrated circuit according to Claim 143, wherein the said processor means deenergizes the storage device and the storage circuit means when an amount of the media data stored in said memory means is at least a first predetermined value.

146. An integrated circuit according to Claim 145, wherein the said processor means energizes the storage device prior to energizing the storage circuit means when an amount of the media data stored in the memory means goes below a second predetermined value.

147. An integrated circuit according to Claim 143, wherein said processor means comprises a counting means to count an amount of data transferred to and from the memory means.

148. An integrated circuit according to Claim 147, wherein the said processor means deenergizes the storage device and the storage circuit means when the count of the media data stored in the memory means is at least a first predetermined value.

149. An integrated circuit according to Claim 148, wherein the said processor means energizes the storage device prior to energizing the storage circuit means when the count of the media data stored in the memory means goes below a second predetermined value.

150. An integrated circuit according to Claim 143, said processor means comprises timing means for determining a first time when data is transferred to said memory means and a second time when data is transferred from said memory means.

151. An integrated circuit according to Claim 150, wherein the said processor means deenergizes the storage device and the storage circuit means when the first time is at least a first predetermined value.

152. An integrated circuit according to Claim 151, wherein the said processor means energizes said storage device prior to energizing said storage circuit means when second time is at least a second predetermined value.

153. A method of playing and recording media data from a media player/recorder , said method comprising the steps of:

a. energizing a storage device storing media data;

b. after step a energizing a storage circuit;

c. transferring the media data stored on the storage device via the storage circuit to a memory;

154. A method according to claim 153, further comprising the step of:

(d) deenergizing the storage device and storage circuit in accordance with an amount of data transferred to the memory.

155. A method according to claim 153, further comprising the steps of:

(d) determining when an amount of data transferred to the memory is at least a first predetermined amount; and

(e) deenergizing the storage device and storage circuit when the amount of data transferred to the memory is at least a first predetermined amount as determined in step (d).

156. A method according to claim 153, further comprising the steps of:

(d) counting an amount of data transferred to the memory; and

(e) deenergizing the storage device and storage circuit when the amount of data transferred to the memory counted in step (d) is at least a first predetermined amount as determined in step (d).

157. A method according to claim 153, further comprising the steps of:

(d) timing when data is transferred to the memory; and

(e) deenergizing the storage device and storage circuit when the time timed in step (d) is at least a first predetermined amount as determined in step (d).

158. A method according to claim 156, further comprising the steps of:

(f) counting an amount of data in the memory;

(g) energizing the storage device storing media data when the amount of data in the memory counted in step (f) goes below a second predetermined amount; and

(h) after step (g) energizing the storage circuit.

159. A method according to claim 155, further comprising the steps of:

(f) determining when an amount of data in the memory goes below a second predetermined amount;

(g) energizing the storage device storing media data when the amount of data in the memory goes below the second predetermined amount as determined in step (f); and

(h) after step (g) energizing the storage circuit.

160. A method according to claim 157, further comprising the steps of:

(f) timing when data is transferred from the memory;

(g) energizing the storage device storing media data when the time timed in step (f) is at least a second predetermined amount; and

(h) after step (g) energizing the storage circuit.

161. A computer program for playing and recording media data from a media player/recorder , said computer program comprising the steps of:

(a) energizing a storage device storing media data;

(b) after step a energizing a storage circuit;

(c) transferring the media data stored on the storage device via the storage circuit to a memory;

162. A computer program according to claim 161, further comprising the step of:

(d) deenergizing the storage device and storage circuit in accordance with an amount of data transferred to the memory.

163. A computer program according to claim 161, further comprising the steps of:

(d) determining when an amount of data transferred to the memory is at least a first predetermined amount; and

(e) deenergizing the storage device and storage circuit when the amount of data transferred to the memory is at least a first predetermined amount as determined in step (d).

164. A computer program according to claim 161, further comprising the steps of:

(d) counting an amount of data transferred to the memory; and

(e) deenergizing the storage device and storage circuit when the amount of data transferred to the memory counted in step (d) is at least a first predetermined amount as determined in step (d).

165. A computer program according to claim 161, further comprising the steps of:

(d) timing when data is transferred to the memory; and

(e) deenergizing the storage device and storage circuit when the time timed in step (d) is at least a first predetermined amount as determined in step (d).

166. A computer program according to claim 164, further comprising the steps of:

(f) counting an amount of data in the memory;

(g) energizing the storage device storing media data when the amount of data in the memory counted in step (f) goes below a second predetermined amount; and

(h) after step (g) energizing the storage circuit.

167. A computer program according to claim 163, further comprising the steps of:

(f) determining when an amount of data in the memory goes below a second predetermined amount;

(g) energizing the storage device storing media data when the amount of data in the memory goes below the second predetermined amount as determined in step (f); and

(h) after step (g) energizing the storage circuit.

168. A computer program according to claim 165, further comprising the steps of:

(f) timing when data is transferred from the memory;

(g) energizing the storage device storing media data when the time timed in step (f) is at least a second predetermined amount; and

(h) after step (g) energizing the storage circuit.

169. A media player/recorder comprising:

a storage device to store media data, the media data comprising a plurality of selections;

a memory;

a processor to transfer first portions of at least one of the plurality of selections of the media data from said storage device to said memory;

an output device,

wherein said output device outputs the first portions of the at least one of the plurality of sections of the media data from the memory,

wherein when a user selects a particular one of said plurality of selections, said processor retrieves a remaining portion of the particular one of said plurality of selections and said output device outputs the portion and remaining portion the particular one of said plurality of selections.

170. A media player/recorder comprising:

storage means for storing media data, the media data comprising a plurality of selections;

memory means for storing data;

processing means for transferring first portions of at least one of the plurality of selections of the media data from said storage means to said memory means;

an output means for outputting the first portions of the at least one of the plurality of sections of the media data from said memory means,

wherein when a user selects a particular one of said plurality of selections, said processing means retrieves a remaining portion of the particular one of said plurality of selections and said output means outputs the portion and remaining portion the particular one of said plurality of selections.

171. A method of playing and recording media data from a media player/recorder , said method comprising the steps of:

(a) storing media data, the media data comprising a plurality of selections;

(b) transferring first portions of at least one of the plurality of selections of the media data from step (a) to a means;

(c) outputting the first portions of the at least one of the plurality of sections of the media data from the memory,

wherein when a user selects a particular one of said plurality of selections, then retrieving a remaining portion of the particular one of said plurality of selections and then outputting the portion and remaining portion the particular one of said plurality of selections.

172. A computer program for playing and recording media data from a media player/recorder , said method comprising the steps of:

(a) storing media data, the media data comprising a plurality of selections;

(b) transferring first portions of at least one of the plurality of selections of the media data from step (a) to a means;

(c) outputting the first portions of the at least one of the plurality of sections of the media data from the memory,

wherein when a user selects a particular one of said plurality of selections, then retrieving a remaining portion of the particular one of said plurality of selections and then outputting the portion and remaining portion the particular one of said plurality of selections.

ABSTRACT

A media player/recorder is provided comprising a storage device to store compressed media data, such as MP3 data. A processor is provided to retrieve the media data stored in the storage device, and a memory stores the media data retrieved by the processor. The processor decompresses the media data stored in the memory, and an output circuit to output the decompressed media data from the processor.

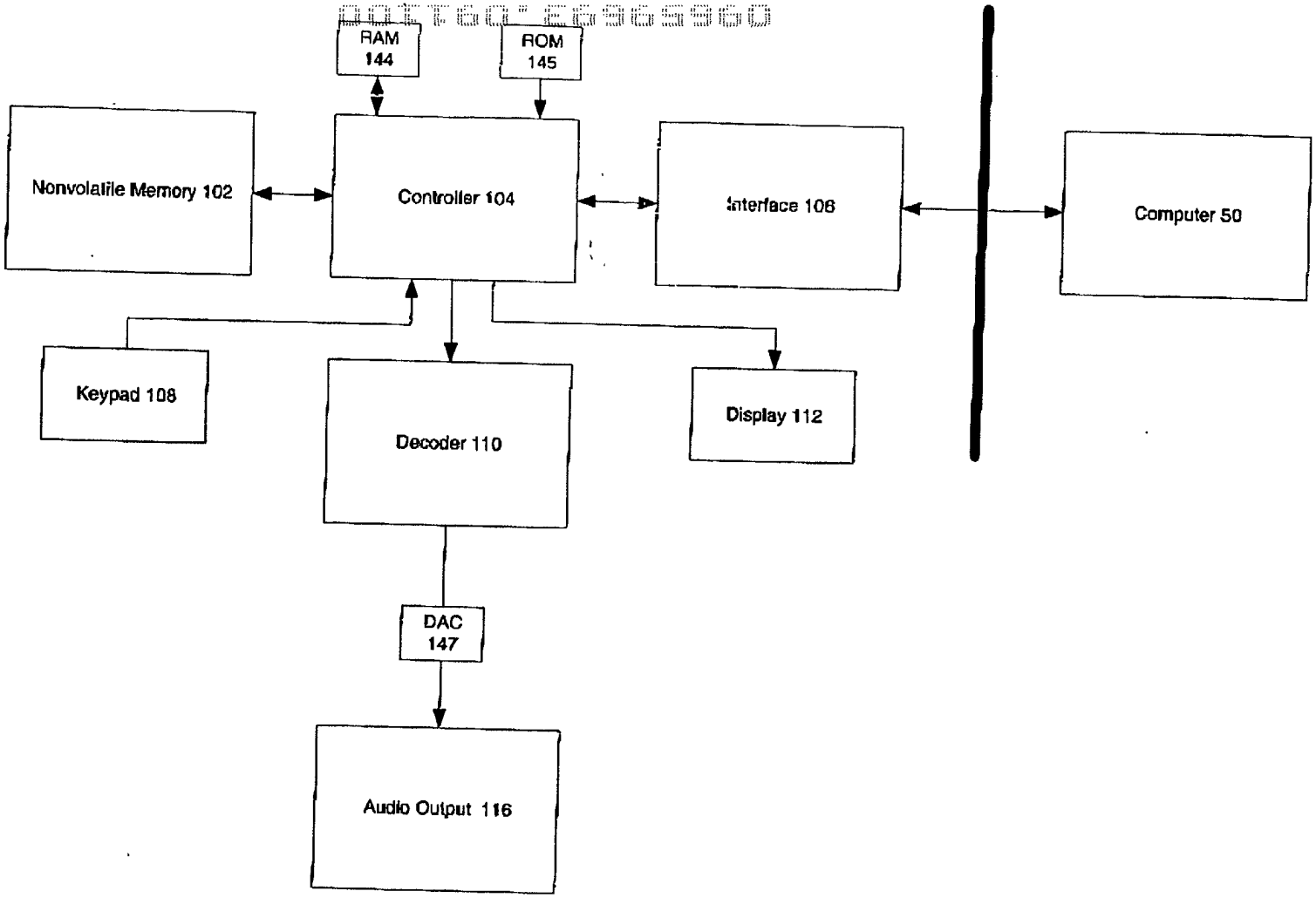

RAM
144
ROM
145
Nonvolatile Memory 102
Controller 104
Interface 106
Computer 50
Keypad 108
Decoder 110
Display 112
DAC
147
Audio Output 116

FIG. 1

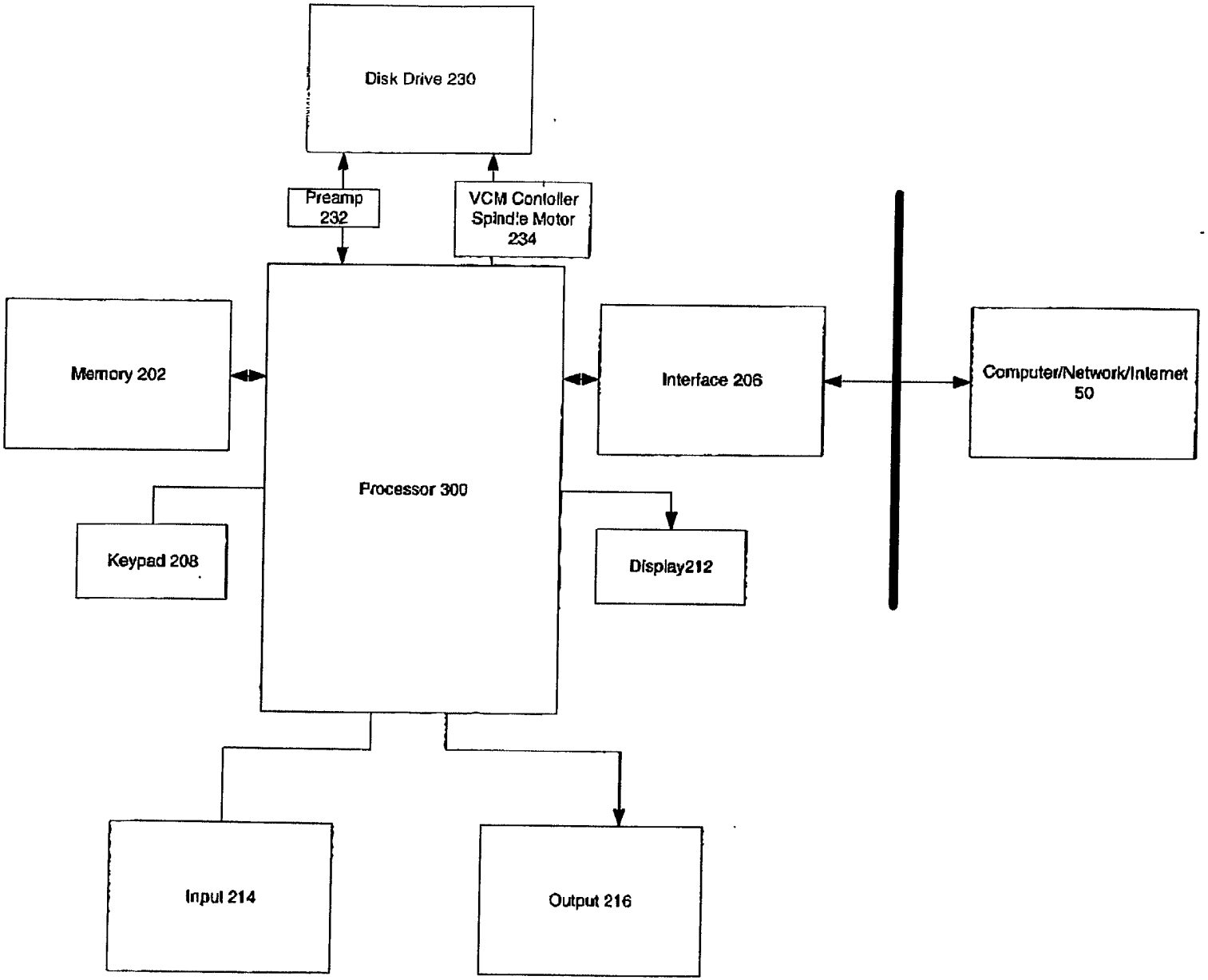


FIG. 2

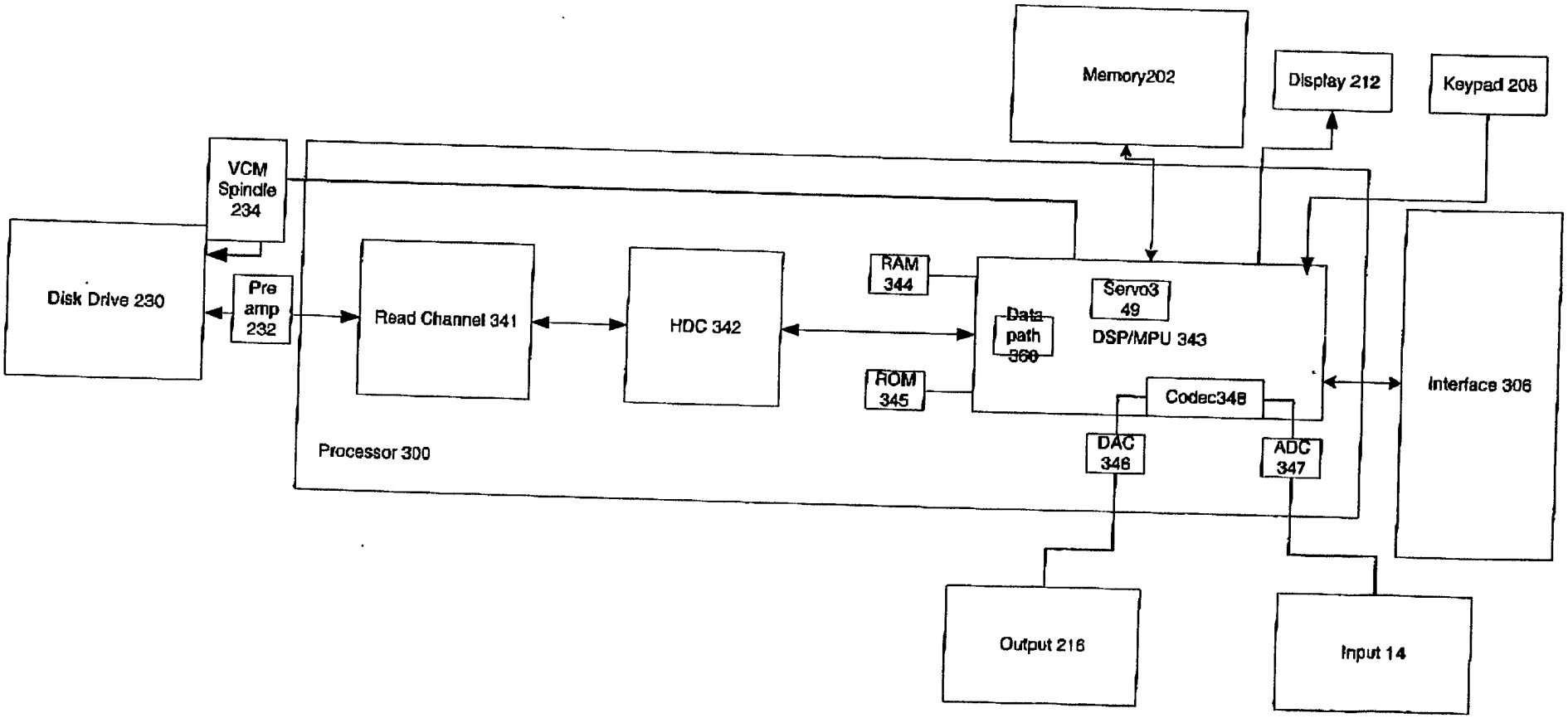


FIG. 3

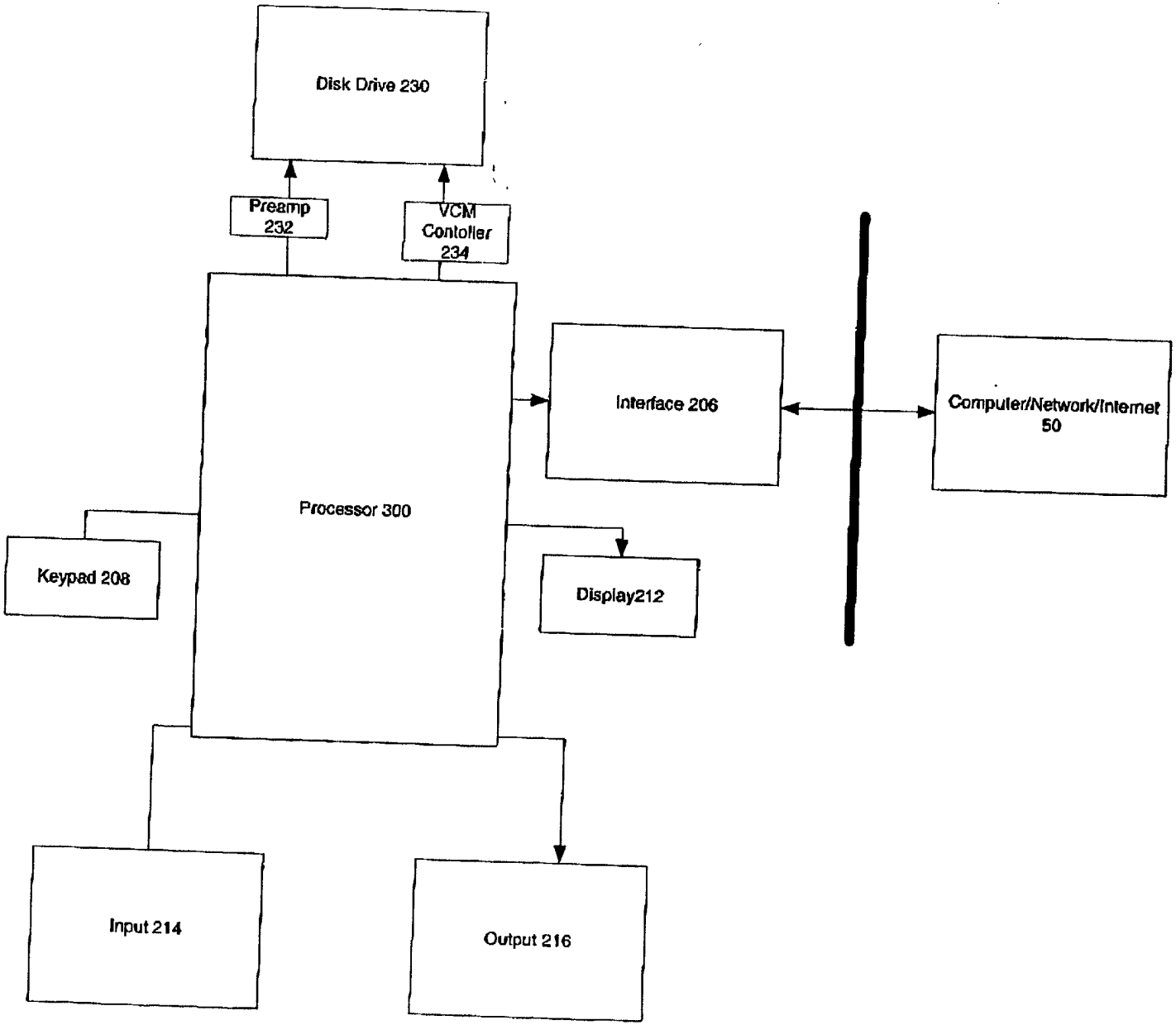


FIG. 4

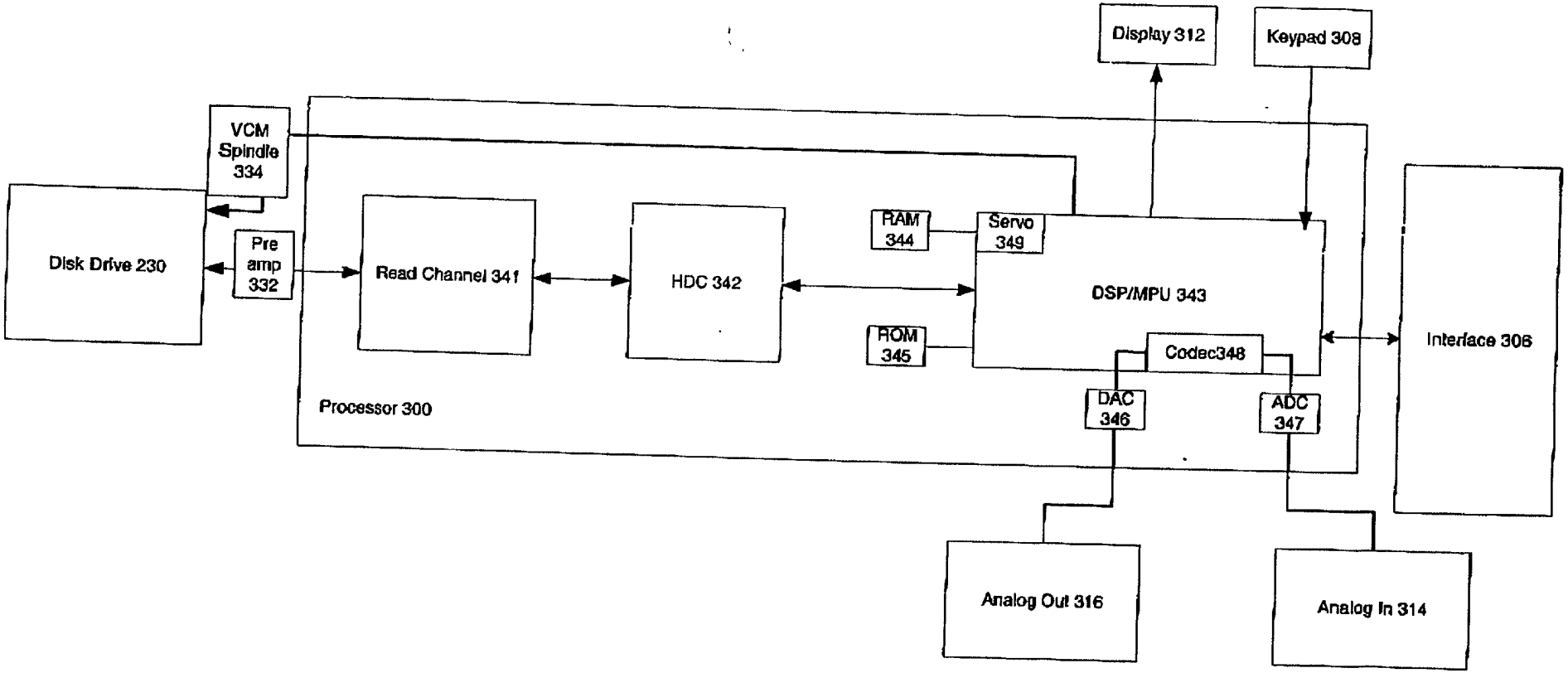
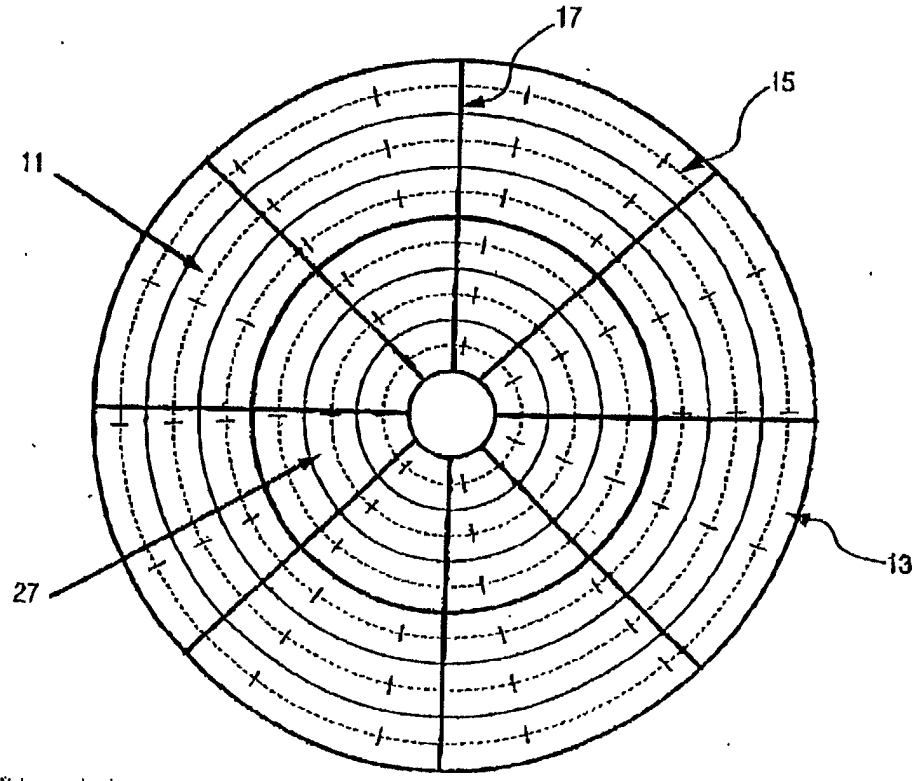


FIG. 5

Fig 6



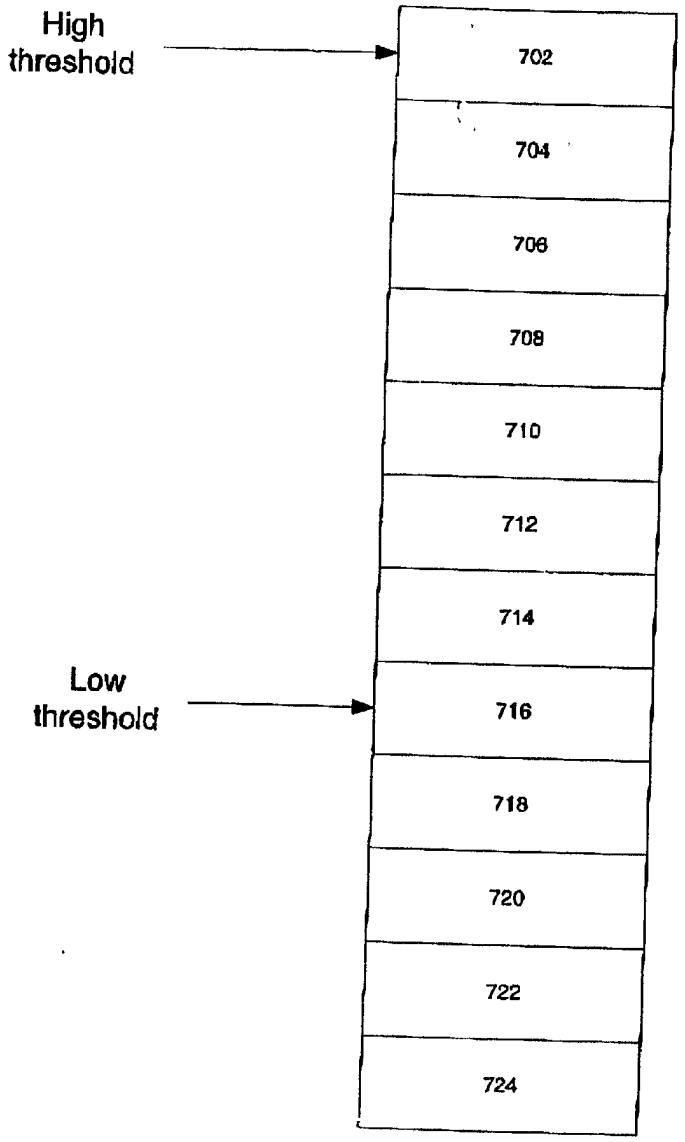


Fig. 7

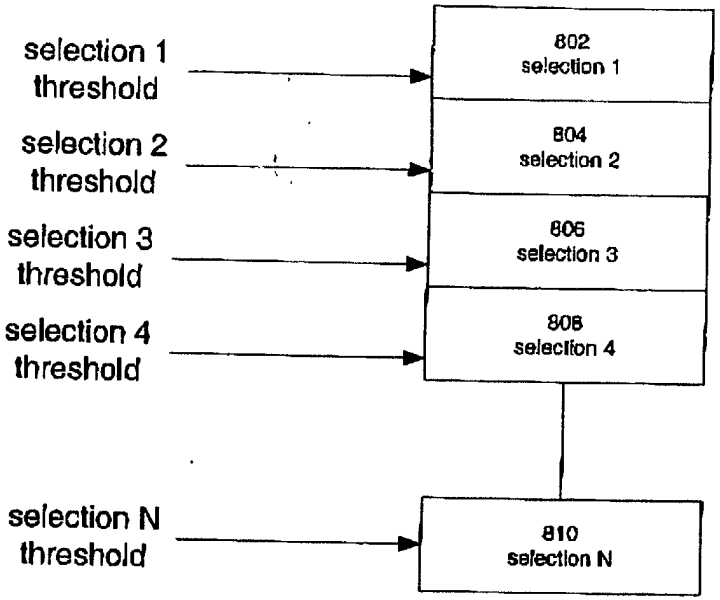


Fig. 8

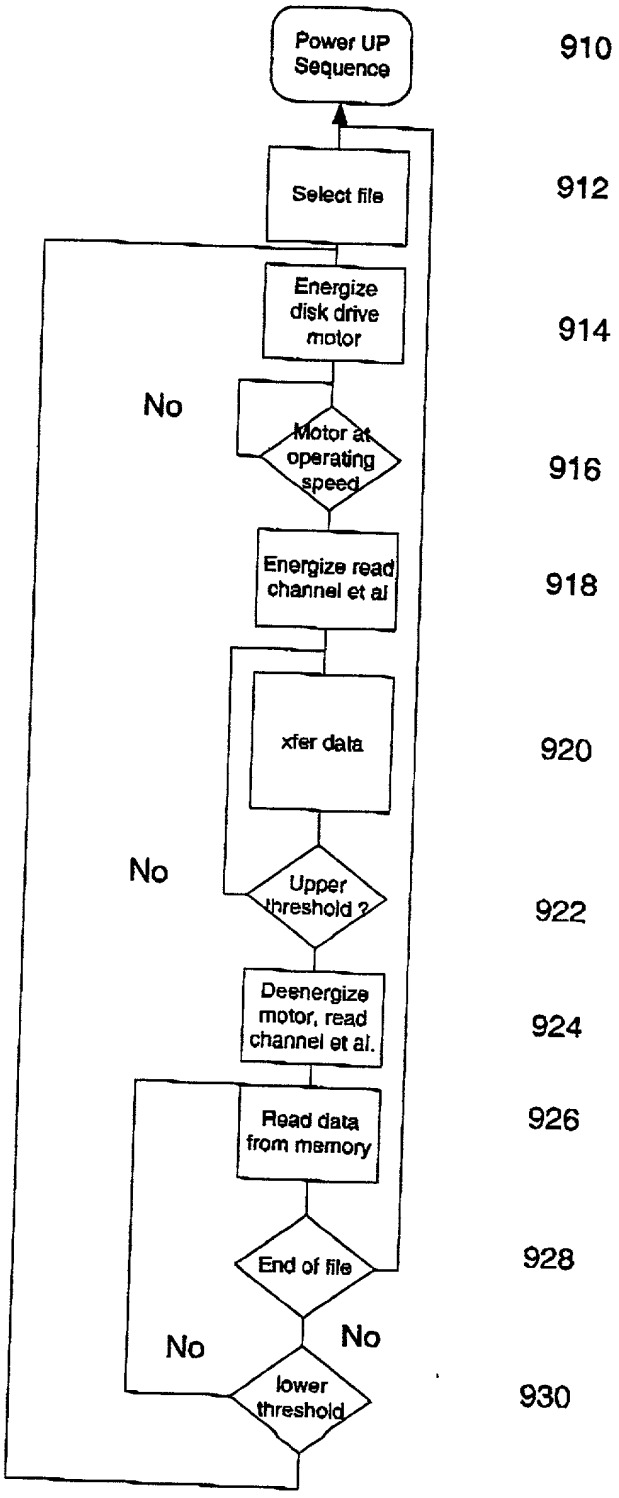

Power UP Sequence
910
Select file
912
Energize disk drive motor
914
No
Motor at operating speed
916
Energize read channel et al
918
xfer data
920
No
Upper threshold ?
922
Deenergize motor, read channel et al.
924
Read data from memory
926
End of file
928
No
No
lower threshold
930

FIG 9

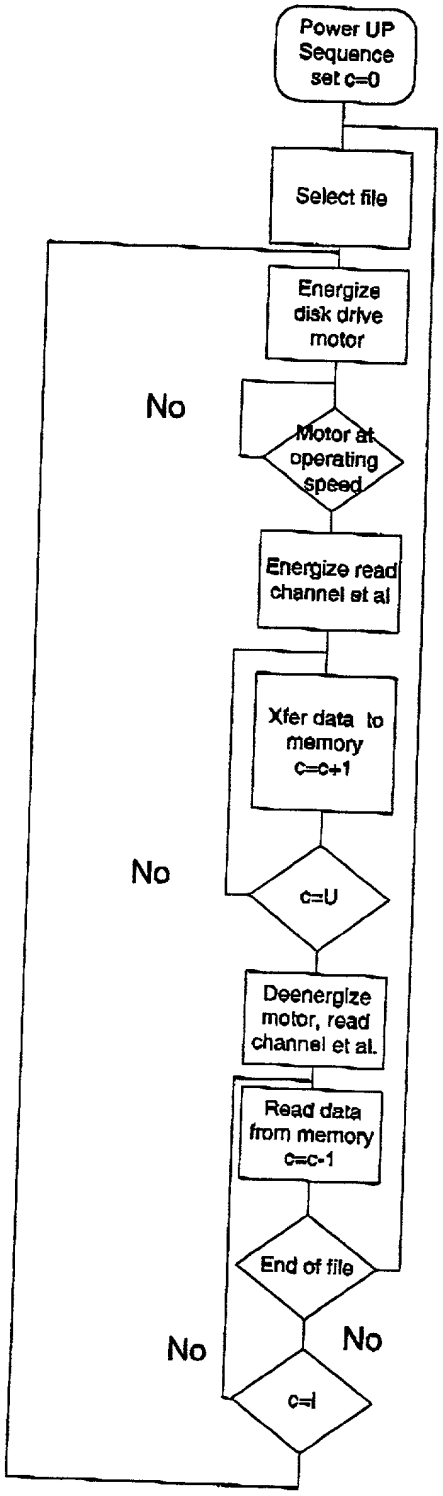

Power UP Sequence set c=0
1010
Select file
1012
Energize disk drive motor
1014
No
Motor at operating speed
1016
Energize read channel et al
1018
Xfer data to memory c=c+1
1020
No
c=U
1022
Deenergize motor, read channel et al.
1024
Read data from memory c=c-1
1026
End of file
1028
No
No
c=I
1030

FIG 10

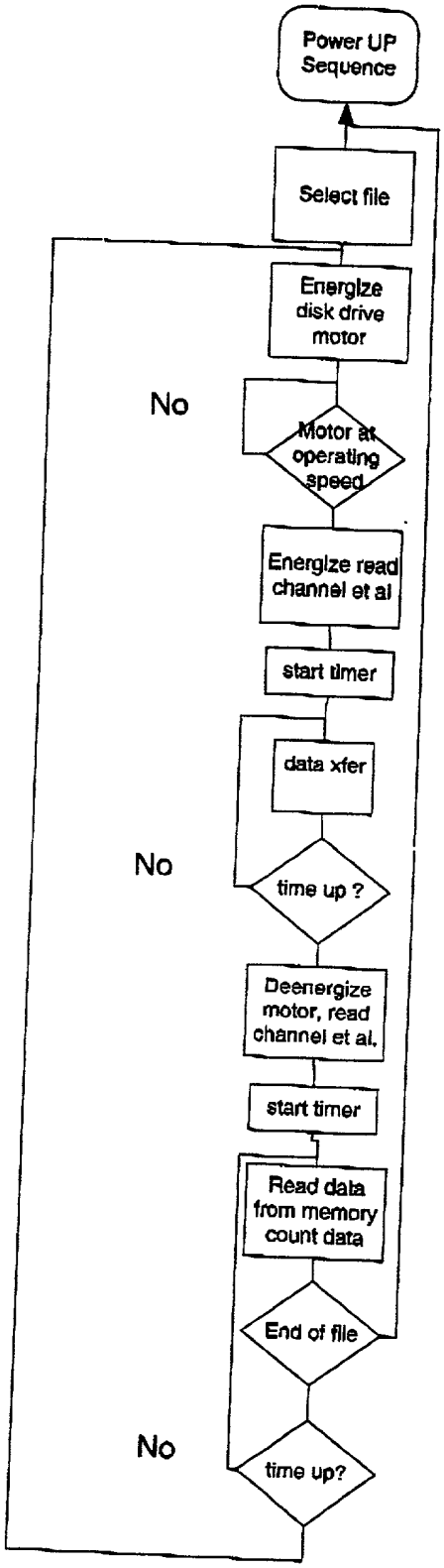

Power UP Sequence
1110
Select file
1112
Energize disk drive motor
1114
No
Motor at operating speed
1116
Energize read channel et al
1118
start timer
1119
1120
data xfer
No
time up ?
1122
Deenergize motor, read channel et al.
1124
start timer
1125
Read data from memory count data
1126
End of file
No
1128
No
time up?
1130

FIG 11

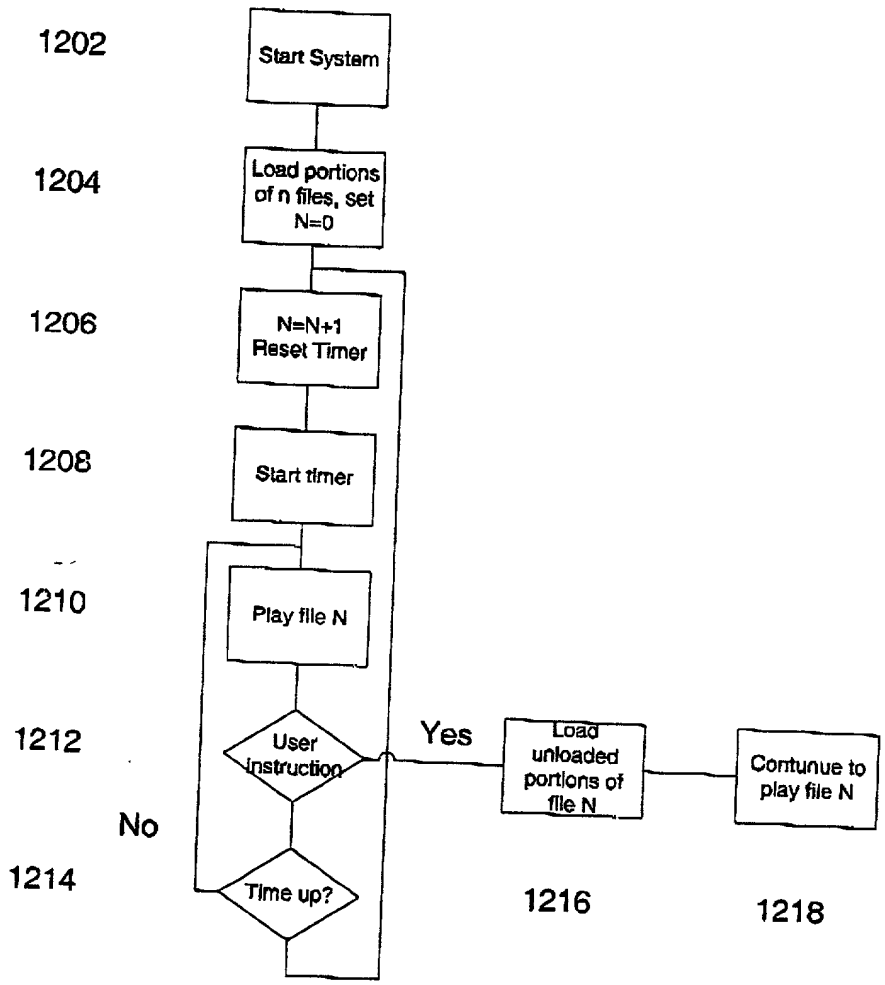

1202
Start System
1204
Load portions of n files, set N=0
1206
N=N+1 Reset Timer
1208
Start timer
1210
Play file N
1212
User Instruction
Yes
Load unloaded portions of file N
Contunue to play file N
No
1214
Time up?
1216
1218

Fig. 12

COMBINED DECLARATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
(Page 1)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled **Method And Apparatus For Recording And Reproducing Digital Data**

[ ] the specification of which is attached hereto X was filed on __ as United States Application No. or PCT International Application No. _
and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b), of any foreign application(s) for patent or inventor's certificate, or § 365(a) of any PCT international application which designates at least one country other than the United States, listed below and have also identified below any foreign application for patent or inventor's certificate, or PCT international application having a filing date before that of the application on which priority is claimed:

Country	Application No.	Filed (Day/Mo./Yr.)	(Yes/No) Priority Claimed

I hereby claim the benefit under 35 U.S.C. § 119(e) of any United States provisional application(s) listed below:

Application No.	Filed (Day/Mo./Yr.)
60/211,874,	June14, 2000

I hereby claim the benefit under 35 U.S.C. § 120 of any United States application(s), or § 365(c) of any PCT international application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT international application in the manner provided by the first paragraph of 35 U.S.C. § 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. § 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

...ATION AND POWER OF ATTORNEY
FOR PATENT APPLICATION
(Page 2)

Application No.	Filed (Day/Mo./Yr.)	Status (Patented, Pending, Abandoned)

I hereby appoint the practitioners associated with the firm and Customer Number provided below and Eric B. Janofsky, Reg. No. 30,759 to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith, and direct that all correspondence be addressed to the address associated with that Customer Number:

FITZPATRICK, CELLA, HARPER & SCINTO
Customer Number: 05514

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Full Name of Sole or First Inventor **Sutardja, Sehat**
Inventor's signature Sehat Sutardja
Date 9/11/00 Citizen/Subject of **United States of America**
Residence **11572 Seven Springs Drive , Cupertino, CA, 95014,**

Post Office Address

Full Name of Second Joint Inventor, if any
Second Inventor's signature
Date Citizen/Subject of
Residence

Post Office Address

Full Name of Third Joint Inventor, if any
Third Inventor's signature
Date Citizen/Subject of
Residence

Post Office Address

Full Name of Fourth Joint Inventor, if any
Fourth Inventor's signature
Date Citizen/Subject of
Residence

STATEMENT CLAIMING SMALL ENTITY STATUS
(37 CFR 1.9(f) & 1.27(c)—SMALL BUSINESS CONCERN

DOCKET NUMBER
MP0062

Applicant, Patentee, or Identifier:
Application or Patent No.
Filed or Issued:
Title: Method And Apparatus For Recording And Reproducing Digital Data

I hereby state that I am
__X__ the owner of the small business concern identified below:
_____ an official of the small business concern empowered to act on behalf of the concern identified below:

NAME OF SMALL BUSINESS CONCERN: Marvell Technology Group Ltd.
ADDRESS OF SMALL BUSINESS CONCERN: Richmond House, 3rd floor, 12 Parla Ville Road, Hamilton HM DX, Bermuda.

I hereby state that the above identified small business concern qualifies as a small business concern as defined in 13 CFR Part 121 for purposes of paying reduced fees to the United States Patent and Trademark Office. Questions related to size standards for a small business concern may be directed to: Small Business Administration, Size Standards Staff, 409 Third Street, SW, Washington, DC 20416.

I hereby state that rights under contract or law have been conveyed to and remain with the small business concern identified above with regard to the invention described in:

_____ the specification filed herewith with title as listed above.
_____ the application identified above.
_____ the patent identified above.

If the rights held by the above identified small business concern are not exclusive, each individual, concern, or organization having rights in the invention must file separate statements as to their status as small entities, and no rights to the invention are held by any person, other than the inventor, who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person made the invention, or by any concern which would not qualify as a small business concern under 37 CFR 1.9(d), or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization having any rights in the invention is listed below:
__X__ no such person, concern, or organization exists.
_____ each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

NAME OF PERSON SIGNING Eric Janofsky

TITLE OF PERSON IF OTHER THAN OWNER General Patent Counsel

ADDRESS OF PERSON SIGNING 645 Almanor Ave Sunnyvale CA 94085

SIGNATURE _____ DATE 5/14/02